DOCUMENT RESUME

ED 137 579 CE 010 592

AUTHOR Mertens, Donna M.
TITLE Formal Level Functioning: A Scientific Phenomenon?
PUB DATE Apr 77
NOTE 28p.; Paper presented at the Annual Meeting of the American Educational Research Association (New York City, April 1977)

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS Adult Development; Classroom Communication; Cognitive Development; *Cognitive Style; *Developmental Stages; Educational Research; Interpersonal Relationship; Learning Processes; Literature Reviews; Student Teacher Relationship; *Teacher Behavior; *Teacher Role; *Theories
IDENTIFIERS *Piaget (Jean)

ABSTRACT

The paper presents an overview of Piaget's theory of cognitive development and a review of research in the measurement of formal operations and the impact of the domain of expertise on cognitive functioning. The role of the teacher as described by proponents of Piaget's theory is explored, along with an extensive description of Piaget's stage of formal operations and an outline of domains of teaching behavior. From these descriptions, conceptual correspondence is derived between formal operations theory and teaching behavior. It is noted that if such behaviors do occur in the classroom, then Piaget's theory of human development and his contention that domain of expertise is an influential factor for adult cognitive development may be supported. (MF)

Paper presented at the 1977 Annual Meeting of the American Educational Research Association, New York, New York, April 1977

FORMAL LEVEL FUNCTIONING: A SCIENTIFIC PHENOMENON?

Donna M. Mertens

Appalachian Education Satellite Program
University of Kentucky, 302 Bradley Hall
Lexington, KY 40506

A number of research studies have indicated that formal operational functioning in adults may not be as prevalent as is suggested by Piaget's theory. The nature of the tasks used to establish Piaget's theory is one factor which has been suggested to account for this seeming lack of formal operations. The original Inhelder and Piaget tasks were based on a physical science orientation. Because many adults do not function in the world of the physical sciences in their employment or personal lives, they may not manifest formal operations on such tasks. Piaget (1972) has hypothesized that a person's domain of expertise may be an important factor in a person's manifestation of formal operations. In order to empirically test this hypothesis, it is first necessary to establish a conceptual correspondence between Piaget's theory and another domain of expertise. The purpose of the present paper is to explore what formal operations would look like in another domain, specifically, teacher behavior in the classroom.

Relating Piaget's theory to teacher behavior is of value for both theoretical and practical reasons.

Research on teaching can be usefully thought of as falling into the broad domains of interpersonal relations and cognitive behaviors. Piaget's

theory of cognitive development offers a framework which can encompass both the interpersonal and cognitive domains. If teaching behavior can be related to developmental theory, then this provides a basis for an empirical investigation of the influence of the nature of the tasks and the influence of a person's area of expertise on cognitive functioning. Such research could provide insight into a number of facets of Piaget's theory, as well as offer a wide range of implications for teacher education programs.

This paper will provide an overview of Piaget's theory and a review of past research in the measurement of formal operations, including research suggesting the importance of a person's domain of expertise for manifestation of formal operations. The role of the teacher as described by proponent's of Piaget's theory will be explored. An extensive description of Piaget's stage of formal operations and an outline of domains of teaching behavior will be presented. Based on these descriptions, a conceptual correspondence will be derived between formal operations theory and the domain of teaching behavior.

Overview of Theory

Piaget (1970) describes three main stages of cognitive development: 1) a sensorimotor period which lasts from birth to approximately 1 1/2 years of age, 2) preparation for and realization of concrete operations, the pre-operational period lasting from 1 1/2 or 2 to about 6, and the concrete period lasting from 7 to 11, and 3) formal operational stage which begins around 11 or 12 and continues into adulthood. Inhelder and Piaget (1958) extensively described the characteristics of a person operating at the formal level of thinking. The formal stage is marked by the ability to derive

possibilities (rather than actualities) by recombining the variables inherent in a problem, and thus the person is able to generate the full range of possible solutions to a problem.

Measurement of Formal Operations

Since the publication of Inhelder and Piaget's The Growth of Logical Thinking from Childhood to Adolescence (1958), much research has suggested that formal level functioning is not as common as is implied in that work. Table 1 provides a summary of research conducted to measure formal level functioning. The results range from 0 percent on the rings and correlatons tasks to 67 percent on the pendulum, balance, and flexibility tasks.

Based on the results of his research using formal operations tasks Dulit explored the impression given by Inhelder and Piaget in the Growth of Logical Thinking from Childhood to Adolescence (1958) that formal stage thinking is the rule in adolescence. Dulit later learned that the adolescents included in the description of formal level functioning in the Inhelder and Piaget report did not include a report of all cases tested because their purpose was to describe and to formulate the characteristics of the formal stage. Dulit's study indicated that formal stage thinking is far from being commonplace among adolescents or adults. He concluded that it is a potentiality only partially attained by most and fully attained only by some.

Importance of Domain of Expertise

Piaget (1972) recognized that it is highly likely that a person operating within his/her own field will know how to reason in a hypothetical manner. He described the situation as, "They would, therefore, be capable

TABLE 1

SUMMARY OF RESEARCH MEASURING FORMAL OPERATIONS

Author	Task	Age	Percent Formal
Elkind 1961a	Conservation of volume	11-12	27%
Elkind 1961b	Conservation of volume	12-18	47%
Elkind 1962	Conservation of volume	college students	58%
Graves 1972	Conservation of volume	adults	24%
Karplus & Karplus 1970	Paper and pencil task	science teachers	14%
		college physics teachers	40%
Tomlinson-Keasey 1972	Pendulum, balance, and flexibility	11	32%
		19	67%
		54	57%
Juraschek 1974	Equilibrium, probability, chemicals	preservice teachers	52%
Dilling, Wheatley, & Mitchell Note 3	Conservation of volume, separation of variables, equilibrium	university students, non-science, education	32%
Smedslund 1963	Correlation	student nurses	0%
Dulit 1972	Rings	average 14	0%
		average 16-17	35%
		gifted 16-17	57%
		average 20-55	33%
	Chemicals	average 14	10%
		average 16-17	17%
		gifted 16-17	62%
		average 20-55	25%

of thinking formally in their particular field, whereas faced with our experimental situations, their lack of knowledge or the fact they have forgotten certain ideas that are particularly familiar to children still in school or college, would hinder them from reasoning in a formal way, and they would give the appearance of being at the concrete level (p.10)." He further stated that aptitude and vital interest appear to be important factors in the manifestation of formal operations.

Elkind (1975) concurs with Piaget's position, and yet he sees difficulties inherent within it. He states, "It would be wrong to infer that the subjects who failed the volume conservation task were deficient in formal operations. What needs to be done is to test such subjects in tasks that require formal operations, but that are in their particular domain of expertise (p.53)." The purpose of the present study is to study formal level functioning in teachers in educational matters. But Elkind's continuing remarks highlight the problems with this approach. He continues: "Piaget's suggestion (1972) that people be tested in formal operations in their area of specialization seems reasonable in principle but difficult to achieve in practice. How does a salesman, a shoe clerk, or a carpenter use formal operations? To be sure some areas of specialization may require formal operational thinking, but not all occupations do. Devising tests of formal operations for specific fields is a difficult task but one that has to be attempted if the question of the generality or universality of formal operations is to be answered (p.53)."

Blasi and Hoeffel (1974) addressed the problem that arises in trying to translate Piaget's description of formal level functioning into "social behavior". Because formal operations theory was derived from physics,

the kind of possibility involved is limited to the possibility of derivations from physical premises. The equilibrium properties of physical systems may not be found outside the domain of physics. There are other types of possibility that do not seem to fit the concept of physical possibility. Psychological or subjective possibility is different from physical possibility because it is difficult to understand psychological factors like obedience or love as an effect of balanced and unbalanced factors. Psychological possibility is not derived from rigidly compensated systems. Therefore, a one-to-one correspondence may not be possible between Piaget's original formulation of the theory of formal operations and teacher behavior.

In Flavell's (1970) reflections on cognitive changes in adulthood, he discusses the fact that biological constraints do not operate as strongly in adult cognitive development as they do in childhood, and therefore, that experience plays a larger role in adult development. He recognizes occupational activities as important sources of changes in adults. He further states that most adult cognitive changes probably involve constructing implicit models of the social-personal world rather than the logical-natural world. He states: "Cognitive changes of this ilk, brought about through significant and impactful life experiences, have apparently been little studied by psychologists (p.250)." However, he does reflect some hope for studying adult cognitive development when he states, "....we should not be too hasty in giving up the search for universal or near-universal cognitive changes in adulthood, changes presumably based on subtle and hard-to identify commonalities of adult experience (p.252)."

The challenge presented in the present paper is to determine if the basic skills being tapped by the standard Piagetian tasks can be translated into an educational context.

Role of the Teacher based on Piaget's Theory

A number of researchers have described the educational implications of Piaget's theory, however little empirical research exists to support these descriptions (Furth, 1970; Kamii, 1973; Piaget, 1970 & 1972; Schwebel and Raph, 1973 and Wickins, 1973). In both To Understand is to Invent and the Science of Education and the Psychology of the Child, Piaget describes the role of the teacher as one who clearly operates at a formal level of functioning in educational matters. The teacher must be able to generate alternative hypotheses for activities such as ways of teaching information to children who are not learning by one method, or how to handle discipline problems. The teacher needs to consider all possibilities, conduct systematic investigations, isolate important factors, eliminate irrelevant factors, and generate possible solutions.

Piaget (1972) describes the need for a child to engage in active learning in order to develop his intelligence. An active method which gives broad scope to the spontaneous research of the child or adolescent would require that every new truth to be learned be rediscovered or at least reconstructed by the student. The role of the teacher then becomes one of organizing the situations which present useful problems to the child, and to provide counter examples that compel reflection and reconsideration of hasty solutions. Students need to carry out their own experiments in order to understand the experimental process. When the student reaches 11 or 12,

experiences that involve dissociating factors and introducing variation into each one in isolation by holding the others constant will provide experience with true experimentation.

Kamii (1973a) suggests that children should be encouraged to raise their own questions and to try to answer them on the basis of their own initiative and resourcefulness. In a related article (Kamii, 1973b), she suggested that the teacher's role is to strengthen the child's own reasoning processes rather than imposing and reinforcing the correct answer. Wickins (1973) expanded this idea by suggesting that the teacher avoid making value statements, but instead elecit self-evaluative comments from the child. He suggested that interaction among peers should be encouraged because having one's views questioned requires a defense and justification of one's opinions and facilitates movement toward understanding another's perspective.

Before a framework can be established for relating Piaget's theory to formal level functioning in the classroom, it is necessary to more fully explore Piaget's theory of formal operations and to relate this theory to domains of teacher behavior. The next sections include an extensive description of Piaget's formal operations theory, a review of literature concerning a delineation of domains of teacher behavior, and the establishment of a correspondence between these domains and Piaget's theory.

Description of Formal Operation Theory

The changes that occur with the onset of formal operations are described by Inhelder and Piaget (1958) as follows: "The coordination of the groupings of classes and relations into a single system requires the introduction of a new structure, that of the 'structured whole' with its

n by n combinatorial system (p.303)." Formal reasoning implies the elaboration of two new structures: the combinatorial system and the INRC group. The combinatorial system allows the person to generate all possible solutions and to relate any factor to any other, therefore allowing the person to reason in a hypothetical manner. Combinatorial operations constitute an operational schema, or a method or way of proceeding which on some occasions is adopted spontaneously and at other times intentionally when the subject is faced with a problem whose solution requires a systematic table of combinations. The INRC group allows a person to combine in one operation the negation and reciprocity found at the concrete level. It allows the person to understand the difference between the cancelling of an effect and the compensation of this effect by another variable which does not eliminate but neutralizes the effect (Piaget, 1972).

The biggest difference between concrete and formal functioning is the ability to reason in terms of verbally stated hypotheses or propositions rather than in terms of concrete objects. Socially, it becomes possible to adopt the other person's point of view, logically deduce its consequences, and thereby judge its value. Formal operations make it possible for the person to isolate variables and deduce potential relationships which can be later verified by experiement.

Piaget (1972) expanded the notion of formal operations from adolescence to adulthood, and suggested that individual aptitudes and selection of a profession would greatly influence the manifestation of formal operations. Adults operating at the formal level exhibit the same process of reasoning in a hypothetical manner, dissociating variables, relating terms in a combinatorial manner, and reasoning with propositions involving negation

and reciprocity. However, this process occurs in the adult's field of specialization. The lawyer may be formal in law and the mechanic in mechanics, but the reverse most certainly need not be true. Adults are most likely to exhibit formal level functioning in situations which involve vital interests

A number of the basic theoretical concepts that Piaget discusses are of particular relevance to this study. The following section explores the concepts of performance-competence and horizontal décalage.

Performance-Competence. The distinction that Flavell and Wohlwill (1969) make between performance and competence provides additional insight into the reasons that many adults do not manifest formal operations on the traditional Piagetian tasks.

Flavell and Wohlwill presented a performance-competence model for formal operations. When Piaget is speaking about logico-mathematical structures, the INRC group and propositional thinking, he is speaking about the competence aspect of formal operations. Most normal adolescents and adults, particularly in Western cultures, have the potential to develop formal thought competence. When research on formal thought finds a large percentage of adolescents not solving formal thought problems, we may be speaking about their poor performance, not their competence.

As Martorano (Note 4) points out, competence refers to an abstract, formalized description of the knowledge that an individual has at a particular developmental stage. Performance refers to the psychological processes by which the knowledge of competence is utilized (e.g. attention, memory, or perception). It is possible that the underlying competence is present, but that this is not manifest in the performance. For example, teachers may have underlying competence for formal operational thinking, and not exhibit it in their performance on traditional Piagetian tasks.

Horizontal Décalage. Another aspect of Piaget's theory which may help explain the seeming lack of formal level functioning is the concept of horizontal décalage. Horizontal décalage expresses a chronical difference between the ages of acquisition of operations that bear on different concepts (contents) but obey identical structural laws, e.g. difference in age of acquisition of the conservation of substance, weight, and volume (Pinard and Laurendau, 1969). Piaget characterizes horizontal décalage as an analogous relationship. The relations among similar operations bearing on different concepts is an analogy in the sense that, in spite of their diversity, the concepts involved seem to be structured according to the same operational rules, with the respective groupings being perfectly isomorphic or analogous among themselves.

During the period in which the newly emerging structures are in the process of formation, a person's responses may be expected to oscillate from one occasion to the next, to be maximally suspectible to the effects of task-related variables, and accordingly evince a relative absence of consistency (Flavell and Wohlwill, 1969). To explain this, Piaget has provided for a stabilization phase, in which newly formed structures are undergoing consolidation and he has proposed the concept of horizontal décalage to account for differentials in performance relating to the particular content of a task or to a variety of situational variables.

Domains of Teaching Behaviors

No strong empirical support for those behaviors which should be included as necessary for effective teaching has yet been established (Smith, 1975). A number of existing theoretic and conceptual paradigms

could form a basis for developing a system of assessment and categorization of teacher's behavior. Piaget's theory of cognitive functioning seems to offer particular potential for organizing an empirical basis because of its implications in the cognitive and interpersonal realm, and because it represents a comprehensive system of notions that logically seem tied to teacher functioning.

In specifying levels of teacher functioning, one useful way to organize the relevant information is to conceptualize teaching behavior as falling into different domains. The competency or performance based curriculum movement has had a significant impact on identifying and defining such domains. A large number of authors have presented logically derived lists of desired teacher skills (Bowles, 1973; Burke and Stone, 1975; Cooper et al., 1973; Flanders, 1973; Henderson, 1972; Henderson and Lanier, 1973,; Kimball, 1974; Morine, 1973; Shavelson, 1973; Smith, 1975; Popham, 1974; Cole, Note 1). General agreement seems to surround the idea that the teacher should exhibit competency in the subject matter which he/she teaches. This has been the traditional focus of teacher education. However, as Cole (Note 2) points out, ".... teacher education programs should help prospective teachers communicate more effectively to their students desirable attitudes toward self, others, learning, school and society as well as competence in the content of the curriculum (p. 7)."

A number of basic skill domains emerge from the literature that could be categorized as an interpersonal relations domain and the cognitive domain that includes instructional planning and implementation skills. These are not mutually exclusive categories, yet all of the ideas seem related to the understanding of the teaching process.

Interpersonal Domain. Walberg and Thomas (1972) describe a domain of teaching that they term humaneness which includes the notions of respect, openness, and warmth. Kimball (1974) included a domain that was necessary for promoting affective growth that he described as sensitivity to the feelings and ideas of others. Bowles (1974) included human relations as a central domain, and Cole and Musser (Note 2) included a skill domain of showing and maintaining respect and regard toward others. Communication skills and creative listening skills are other areas of importance (Cole and Musser, Note 2; Flanders, 1973; Kimball, 1974; Shavelson, 1973).

The interpersonal relations paradigm has a wide base of empirical support in terms of its influence on teaching behavior. Reports by Kratochvil, Carkhuff, and Berenson (1968), Carkhuff (1969a; 1969b), Aspy (1965, 1969), Hefele (1971), and Truax and Tatum (1966) strongly suggest that students are likely to learn most from teachers who show high levels of such attributes as respect and understanding, genuineness, concreteness, and empathy.

Aspy (1975) reported that the National Consortium for Humanizing Education has conducted a large-scale, three year investigation of the effects of contextual variables on classroom performance by teachers and students. The study found that a teacher's empathic understanding of students is positively and significantly related to student cognitive growth.

Cognitive Domain. A second area of major concern is instructional planning and implementation. This is a broad category with many subskills involved. Flanders (1973) included such areas as planning, individualizing and evaluating pupil instruction. Flanders further discusses the necessary

ability of a teacher to inquire into his/her own teaching behavior, regularly using systematic procedures in order to analyze whether different teaching skills are being used appropriately. He also includes flexibility as an important skill area.

Cole and Musser (Note 2) extend this skill area to include fluency and flexibility of thought, perception and response. Popham (1974) suggests the need for the teacher to be able to devise instructional sequences which will work with diverse kinds of learners. Smith (1975) points out that the ability of diagnose learning difficulties and to design educational experiences to meet them is an essential part of instructional planning. And Morine (1973) agrees that the teacher must be able to generate alternative instructional procedures. Walburg and Thomas (1972) include both an instructional skill that concerns how the teacher directs and responds in the classroom, as well as a provisioning skill that relates to the responsibility of the teacher for what is in the classroom.

If formal operations is indeed a stage of cognitive development that begins in adolescence and continues into adulthood, and if the manifestation of this stage occurs in a person's area of vital interest as Piaget alleges (1972), then it seems logical that some type of conceptual correspondence could be established between the formal operations theory derived from physical possibilities and the possibility manifested in the teacher's world of social possibilities. The following sections detail the conceptual relation between Piaget's theory and the cognitive and interpersonal domains of teaching.

Piaget's Theory and Teacher's Cognitive Skills

A direct implication in establishing a correspondence between Piaget's theory and the teachers' cognitive skills lays in the area of instructional design. The formal teacher will exhibit the INRC group and the combinatorial system in the method that he/she uses to organize the instructional materials. The INRC group implies an ability to deal with relationships between propositions. When using this ability, a teacher will be able to present the subject matter in categories, and be able to establish a relationship between those categories.

For example, if she were teaching a unit on national political power, she would present a number of dimensions such as population, natural resources, wealth, land mass, etc. She would be able to rank the nations on each of these dimensions, and formulate a strategy that would allow her to determine the nation's power as a function of the simultaneous interaction of the dimensional ranking. This strategy involves a ranking of rankings and implies that the nation has first been ranked on each dimension, and then each dimension has been ranked in terms of importance to political power, and finally the nation's power is estimated. The concrete teacher would be able to rank a nation on each of these dimensions, but not able to follow through with the formal strategy described above.

The combinatorial system implies that a teacher will first consider all possible variables, and combinations of variables that might have an effect on an event. She would then systematically test out which variables operate in a situation. Her thoughts would procede from construction of hypotheses about the possible, to testing and deducing the interrelationships

in the real event. The concrete teacher would generalize from directly observed instances about the effect of the variables.

Flavell (1977) outlined a number of characteristics of the formal thinker that are relevant to a teacher's cognitive skills. He first noted the formal thinker's tendency to begin thinking about the possible rather than the real. The concrete thinker would burrow right into the problem, while the formal thinker would begin with possibilities, try to determine all possibilities and systematically discover the real.

Flavell described the hypothetico-deductive thought processes of the formal thinker as contrasted to the empirico-inductive processes of the concrete thinker. Thus the formal teacher would be more likely to hypothesize and deduce relationships. The concrete teacher would be more likely to emphasize moving from concrete example to concrete example.

Another distinction between concrete and formal thinking is the intrapropositional vs. interpropositional thinking. The concrete thinker is able to consider a single proposition at a time and to compare it to relevant empirical data. The formal thinker is able to reason about the logical relations that hold among two or more propositions.

The formal thinker is also able to construct a systematic, efficient method for generating all the possible combinations of a set of elements. This ability to generate all possible combinations is essential to testing for the effects of variables. Related to this concept is the idea that formal thinkers tend to be more planful, strategic and efficient than concrete thinkers in their organization and manipulation of available information. This characteristic of formal thinking has definite implications for how a teacher organizes material for classroom presentation.

Piaget's Theory and Teacher Interpersonal Behavior

A conceptual correspondence between Piaget's theory of formal operations and teacher interpersonal behavior is presented in Table 2. Flavell (1977) described a parallel between ability to deal with the possible rather than the real, and the social world. He suggested that the formal person would be more able to go beyond a person's superficial characteristics. The formal person would be able to perceive the covert social-psychological processes that underlie a person's behavior.

In terms of the combinatorial system which implies the ability to generate all possible solutions the likelihood is that this pertains mainly to the realm of "physical possibility" that Blasi and Hoeffel described. In social situations, a close approximation conceptually to this idea would be what Reynolds (1970) described as the ability to construe social behavior in a multidimensional way.

Reynolds (1970) described the cognitively complex individual and then related this description to the behavioral categories of the Flanders Interaction Analysis Categories (FIAC). A more cognitively complex individual has available a more versatile system for perceiving the behavior of others than does a less cognitively complex person, and is therefore able to construe social behavior in a multidimensional way. "The cognitively complex person is seen to be that individual whose cognitive system of construing others has more structure in an informational sense. If this is the case, it is not unreasonable to expect this complex individual to invoke greater structure in the ambiguous social situation, i.e. to perceive a structure that may not be noted by a less complex person (p. 60)."

TABLE 2

FORMAL OPERATIONS AND INTERPERSONAL BEHAVIORS

Formal Operations	Interpersonal Behaviors
Thinking of the possible vs. the real	Able to make inferences about covert social-psychological processes
Generation of all possible solutions	Construe social behavior in a multi-dimensional way
Isolation of variables	Recognition of more possibilities to explain behavior
Derivation of possibilities by recombining the variables inherent in a problem	Postulating alternative interactive strategies
Deduction of potential relationships	Suggesting hypothetical relationships between variables
Able to adopt other's point of view, logically deduce consequences, judge its value	Able to adopt other's point of view, manifest by accepting and using student's ideas and feelings, encouraging student talk, and openess to the ideas of other professionals
Emphasis on active learning	Active learning, including providing an opportunity for student talk and question asking, less lecturing, compelling reflection, and providing opportunity for experimentation

Because the cognitively complex teacher has greater facility for interpreting social situations, he/she would teach in a relatively indirect manner and impose less structure on the classroom interactions. The less complex teacher would be more likely to impose a structure that would reduce the number of ambiguous episodes and would therefore be more direct.

Formal operations also make it possible for the person to isolate variables, derive possibilities by recombining the variables inherent in a problem and deduce potential relationships which can be verified by experiment. Once again this sequence may never occur in a social setting, because of the near impossibility of determining the importance of a variable by systematically testing hypotheses while holding all else constant. Nevertheless, this does relate to Reynolds' description of the cognitively complex individual as having a more versatile system for describing the behavior of others and whose cognitive system of construing others' behaviors has more structure in an informational sense.

Underlying the teacher's method of utilizing a more indirect method of teaching and imposing less structure on the classroom is the idea that more of the relevant variables have been recognized, and that a wider range of teaching strategies are recognized as being related to these variables. Generally such a teacher exhibits an ability to operate in a situation which involves a wide range of variables, to take cognizance of more of those variables, and of a variety of ways to interacting in relation to those variables. He/she realizes that to be able to effectively interact with the variables, a greater diversity in behavioral interactions is required. Such a teacher can operate within a system with many dynamic variables, recognize that those variables exist and that a wide diversity of interactional patterns are required to effectively coordinate all of those variables within the system. The cognitively complex teacher would

thus evidence more indirect teacher talk and a wider diversity of interactional patterns.

Socially, formal operations brings with it the ability to adopt the other person's point of view, logically deduce its consequences, and thereby judge its value. This would be reflected in teacher behaviors such as accepting students' feelings and ideas, asking questions, and a high proportion of student talk.

Conclusion

The present paper explores the literature concerning the measurement of formal operations and the impact of a person's domain of expertise on cognitive functioning. As a first step toward an empirical test of the impact of a person's domain of expertise on cognitive functioning, a conceptual correspondence was established between Piaget's theory and the domain of teaching behavior. The results suggest that it is possible to describe the domain of teaching behaviors within the context of formal operations, although the social nature of teaching behavior limits the preciseness of the correspondence. The next step is to use this conceptual correspondence in an educational setting to determine if such behaviors do occur in the classroom. If such behaviors do occur, then this lends support to Piaget's theory of human development and his contention that domain of expertise is an influential factor for adult cognitive development. It would also provide insight into Piaget's notions of performance-competence and horizontal decalage and would have implications for teacher education programs.

Reference Notes

1. Cole, H. P. Teaching as communication. Unpublished manuscript, University of Kentucky, 1973.

2. Cole, H. P., & Musser, L. S. Process approaches to the teaching of educational psychology. Unpublished manuscript, University of Kentucky, 1975.

3. Dilling, R. A., Wheatley, G. H., & Mitchell, R. An EEG investigation of the differences in the hemispheric specialization of formal and concrete operational persons. Paper presented at the annual meeting of the American Educational Research Association, San Francisco, 1976.

4. Martorano, S. C. Formal operations thinking: Now you see it, now you don't. Paper presented at the biannual meeting of the Society for Research in Child Development, Denver, April, 1975.

References

Aspy, D. N. A study of three facilitative conditions and their relationships to the achievement of third grade students. Unpublished doctoral dissertation, University of Kentucky, 1965.

Aspy, D. N. The effect of teacher-offered conditions of empathy, positive regard, and congruence upon student achievement. Florida Journal of Educational Research, 1969, 11, 39-48.

Aspy, D. N. The relationship between selected student behavior and the teacher's use of interchangeable responses. The Humanist Educator, 1975, 14(1), 3-11.

Blasi, A., & Hoeffel, E. C. Adolescence and formal operations. Human Development, 1974, 17(5), 344-363.

Bowles, F. D. Decision making in instruction. Journal of Teacher Education, 1973, 24(1), 38-40.

Burke, C. D., & Stone, D. R. A research-based learning process model for developing and evaluating teacher education curricula. Journal of Teacher Education, 1975, 26(3), 235-241.

Carkhuff, R. R. Helping and human relations: A primer for lay and professional helpers. Vol. 1: Selection and training. New York: Holt, Rinehart, & Winston, 1969. (a)

Carkhuff, R. R. Helping and human relations: A primer for lay and professional helpers. Vol. 2: Practice and research. New York: Holt, Rinehart, & Winston, 1969. (b)

Cooper, J. M., Jones, H. L., & Weber, W. A. Specifying teacher competencies. Journal of Teacher Education, 1973, 24(1), 17-23.

Dulit, E. Adolescent thinking à la Piaget: The formal stage. Journal of Youth and Adolescence, 1972, 1, 281-301.

Elkind, D. Children's discovery of the conservation of mass, weight, and volume. Journal of Genetic Psychology, 1961, 98, 219-227. (a)

Elkind, D. Quantity conceptions in junior and senior high school students. Child Development, 1961, 32, 551-560. (b)

Elkind, D. Quantity conceptions in college students. Journal of Social Psychology, 1962, 57, 459-465.

Elkind, D. Recent research on cognitive development in adolescence. In S. E. Dragastin, & G. H. Elder (Eds.), Adolescence in the Life Cycle. Washington, D. C.: Hemisphere, 1975.

Flanders, N. A. Basic teaching skills derived from a model of speaking and listening. Journal of Teacher Education, 1973, 24(1), 24-37.

Flavell, J. H., & Wohlwill, J. F. Formal and functional aspects of cognitive development. In D. Elkind et al. (Eds.), Studies in cognitive development. New York: Oxford University Press, 1969.

Flavell, J. Cognitive changes in adulthood. In L. R. Goulet; & P. B. Baltes (Eds.), Life-span developmental psychology: Theory and research. New York: Academic Press, 1970.

Flavell, J. Cognitive development. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1977.

Furth, H. G. Piaget for teachers. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1970.

Graves, A. J. Attainment of conservation of mass, weight, and volume in minimally educated adults. Developmental Psychology, 1972, 7, 223.

Hefele, T. J. The effects of systematic human relations training upon student achievement. Journal of Research and Development in Education, 1971, 46.

Henderson, J. E. A summary of initial efforts in developing competency based teacher training for social-emotional growth. 1972. (ERIC Document Reproduction Service No. ED 098 177).

Henderson, J. E., & Lanier, P. E. What teachers need to know and teach (for survival on the planet). Journal of Teacher Education, 1973, 24 (1), 4-16.

Inhelder, B., & Piaget, J. The growth of logical thinking from childhood to adolescence. New York: Basic Books, 1958.

Juraschek, W. A. Piagetian cognitive development among prospective teachers. Technical Report No. 4. Austin University, Mathematics Education Center, 1974. (ERIC Document Reproduction Service No. ED 106 122).

Kamii, C. Pedagogical principles derived from Piaget's theory: Relevance for educational practice. In M. Schwebel, & J. Raph (Eds.), Piaget in the classroom. New York: Basic Books, 1973. (a)

Kamii, C. Piaget's interactionism and the process of teaching young children. In M. Schwebel, & J. Raph (Eds.), Piaget in the Classroom. New York: Basic Books, 1973. (b)

Karplus, E. F., & Karplus, R. Intellectual development beyond elementary school: Deductive logic. School Science Mathematics, 1970, 70(5) 398-407.

Kimball, R. L. Some aspects of the role of affective development in cognitive development: Relating formal operations learning to emotional maturity. Paper presented at the 4th Annual Conference on

Piaget and the Helping Professions, Los Angeles, California, 1974. (ERIC Document Reproduction Service No. ED 099 122).

Kratochvil, D. R., Carkhuff, R. R., & Berenson, B. L. Cumulative effects of parent and teacher offered levels of facilitative conditions upon indices of student physical, emotional, and intellectual functioning. Journal of Educational Research, 1968, 63, 161-164.

Morine, G. Planning skills: Paradox and parodies. The Journal of Teacher Education, 1973, 24(2), 135-143.

Piaget, J. Piaget's theory. In P. H. Mussen (Ed.), Carmichael's manual of child psychology. New York: John Wiley, 1970.

Piaget, J. The science of education and the psychology of the child. New York: Orion Press, 1970.

Piaget, J. Intellectual evolution from adolescence to adulthood. Human Development, 1972, 15, 1-12.

Pinard, A., & Laurendeau, M. "Stage" in Piaget's cognitive-developmental theory: Exegesis of a concept. In D. Elkind, & J. H. Flavell (Eds.), Studies in cognitive development. New York: Oxford University Press, 1969.

Popham, W. J. Minimal competencies for objectives-oriented teacher education programs. Journal of Teacher Education, 1974, 25(1), 68-73.

Reynolds, R. J. Classroom verbal interaction patterns as a function of instructor cognitive complexity. Journal of Teacher Education, 1970, 21(1), 59-63.

Schwebel, M., & Raph, J. The developing teacher. In M. Schwebel & J. Raph (Eds.), Piaget in the classroom. New York: Basic Books, 1973.

Shavelson, R. J. What is the basic teaching skill? Journal of Teacher Education, 1973, 24(2), 144-161.

Smedslund, J. The concept of correlation in adults. Scandinavian Journal of Psychology, 1963, 4, 165-173.

Smith, B. O. The growth of teacher education: Where to from here? Journal of Teacher Education, 1975, 26(2), 102-104.

Tomlinson-Keasey, C. Formal operations in females from eleven to fifty-four years of age. Developmental Psychology, 1972, 6, 364.

Truax, C. B., & Tatum, C. An extension from the effective psycho-therapeutic model of constructive personality change in preschool children. Childhood Education, 1966, 42, 456-462.

Walburg, H. J., & Thomas, S. C. Characteristics of open education: A look at the literature for teachers. Newton, Mass.: Education Development Center, Inc., TDR Associates, Inc., 1972. (ERIC Document Reproduction Service No. ED 058 164).

Wickins, D. Piagetian theory as a model for open systems of education. In M. Schwebel, & J. Raph (Eds.), Piaget in the classroom. New York: Basic Books, 1973.

Paper presented at the 1977 Annual Meeting of the American Educational Research Association, New York, New York, April 1977.

FORMAL LEVEL FUNCTIONING: A SCIENTIFIC PHENOMENON?

Donna M. Mertens

Abstract

The present paper explores the literature concerning the measurement of formal operations and the impact of a person's domain of expertise on cognitive functioning. As a first step toward an empirical test of the impact of a person's domain of expertise on cognitive functioning a conceptual correspondence was established between Piaget's theory and the domain of teaching behavior. The results suggest that it is possible to describe the domain of teaching behavior within the context of formal operations, although the social nature of teaching behavior limits the precise correspondence. The next step is to use this conceptual correspondence in an educational setting to determine if such behaviors do occur in the classroom. If such behaviors do occur, then this lends support to Piaget's theory of human development and his contention that domain of expertise is an influential factor for adult cognitive development. It would also provide insight into Piaget's notions of performance-competence and horizontal décalage and would have implications for teacher education programs.